The Effects of Melodic Contagions in the Oral Transmission of Melodies

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Abstract

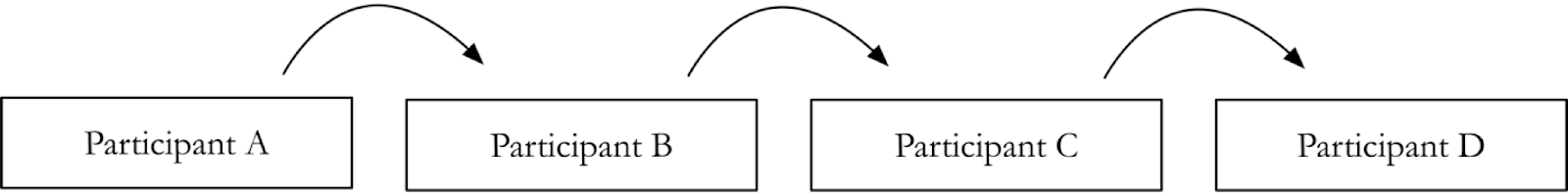
Previous research into the transmission and altering of musical signals has primarily examined recognition tasks, emphasizing the role of memory (e.g. Halpern & Bartlett, 2010). Recent studies suggest that the physical act of melodic production might also play a role. Shanahan and Albrecht (forthcoming) found that ascending stepwise motion at cadences tend to be replaced by descending stepwise motion over the course of oral transmission. The current study hypothesizes that this effect will be amplified by the introduction of . Results are discussed in terms of both the physical affordances of vocal transmission and the statistical learning of musical gestures. This study suggests that certain cadences are more likely to “survive” the act of transmission than others. We argue that surviving cadences align with physical affordances; as such, descending lines are more likely to remain, whereas ascending final cadences are more likely to change. The direction of causality, however, is difficult to test. Are descending lines easier to sing because they’re more common, or are they more common because they’re easier to sing? We discuss possible future directions in which we pick apart this question in more depth.

Introduction

There are a number of reasons why one melody might be more likely to be transmitted than another. Perhaps certain melodies contain features that a reminiscent of specific events; perhaps they are sung my more influential people, and connote status; perhaps melodies that are more prototypical are more likely to be transmitted, or perhaps it’s about simplicity. Recent work by Shanahan and Albrecht (forthcoming) has examined how melodies that are less physically affordant (i.e. those with cadences that ascend, rather than descend), are more likely to be transformed than a descending melody. Put more succinctly, “ti-do” melodies are far more likely to transform into “re-do” melodies than vice versa.

The field of Social Learning focuses on why certain ideas might be more easily lost in transmission than others, and is defined as “learning that is influenced by observation of, or interaction with, another animal…” (Hoppitt and Laland, 2013). This is a very broad scope, encompassing evolutionary biology, animal behavior, and decision theory, among other fields. An example from the animal world includes a Payne and Payne study (1985), that found that male humpback whales in a certain population all sang a song that would gradually change through the season, as various changes were gradually introduced. Similarly, Garland et al. (2011) found that migration of humpback whales created a change in song types that followed the migratory patterns.

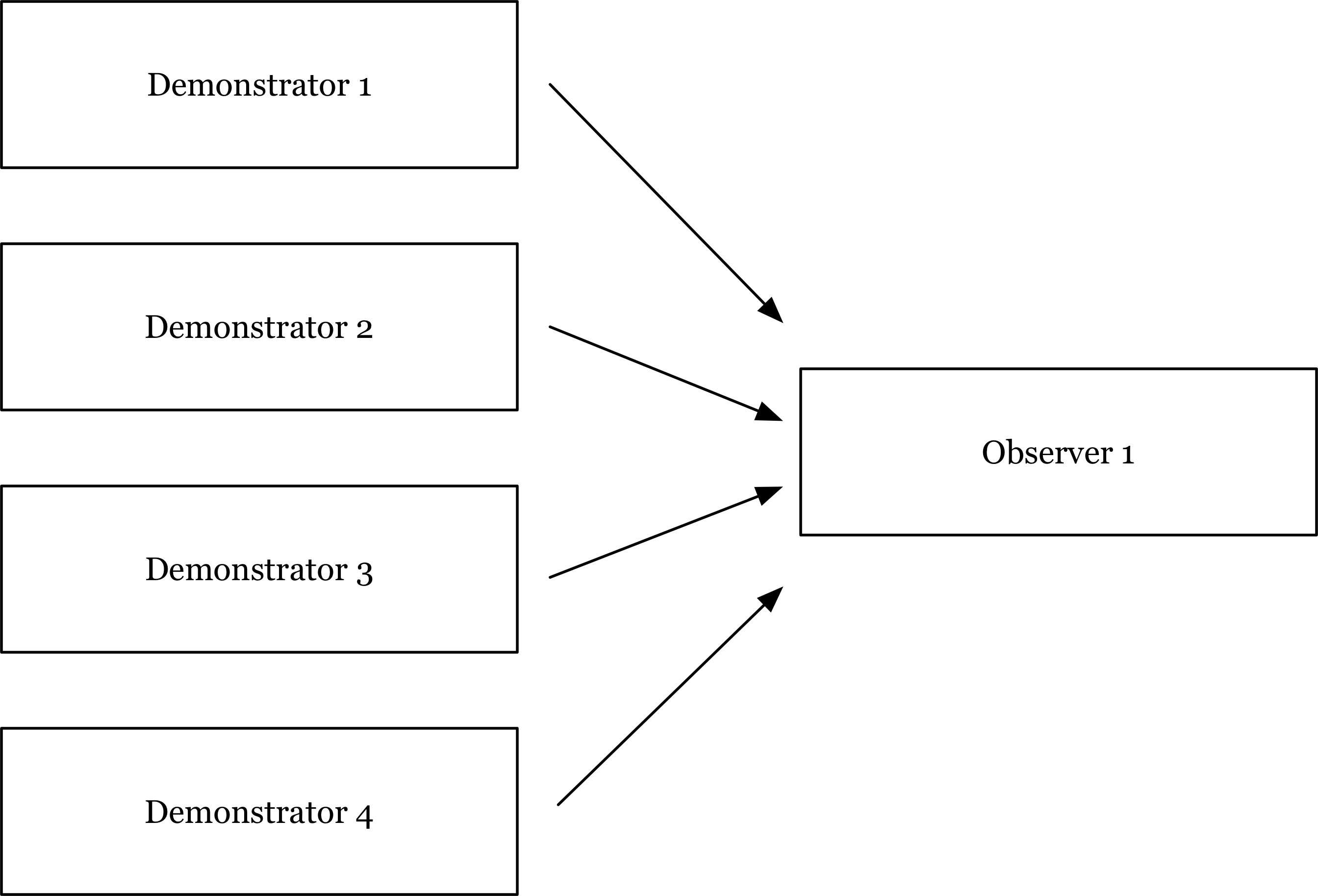
One of the earliest examples of a study focusing on information lost during transmission was Bartlett’s (1932) early work on memory and transmission, which involved participants being presented with either text or a picture, recalling it, and having the result of that recall passed to the next participant, who in turn produced their own version of their recollection to another participant. Bartlett concluded that there are always some features —“dominant features”— that are more easily maintained than others throughout transmission. This type of methodology is known as a “transmission chain.” The simplest form of transmission chain is a linear transmission chain, in which one person directly demonstrates to one observer (see Figure 1).



**Figure 1.  A linear transmission chain, demonstrating a melody from a single demonstrator to a single observer.**

The transmission chain methodology seems particularly appropriate for examining how a musical signal like a melody changes over time. One benefit of this approach is the ability to conduct an experiment in a controlled laboratory environment. On the other hand, it is unlikely that an idea is presented to an observer by only one demonstrator. For example, it is far more likely that a melody will have been sung to someone by multiple people before that person teaches it to someone else.

Perhaps a more ecologically valid approach would be to enlist a diffusion-based model, in which each observer is presented with multiple versions of a melody (see Figure 2). In this paradigm, the observer not only tries to replicate a previously-encountered melody, but they are forced to make a choice regarding which melody they should replicate. In a more complex paradigm, this observer would then become one of four more demonstrators, and this would continue for a number of rounds.



**Figure 2.  A diffusion-based model, in which one observer is presented with options from multiple demonstrators.**

For this study, we were interested in whether the melodies changed in the predicted fashion given multiple demonstrators. Put another way, we were interested in whether “re-do” (^2-^1) melodies would be more likely to be transmitted than “ti-do” melodies, when presented by multiple individuals, and we were interested in how aspects of working memory and musical sophistication might be predictive of the choices observers made.

Methods

Participants

Seventy-two students enrolled at Louisiana State University participated in this study. Forty-two participants were recruited from the School of Music, and thirty participants from the Department of Psychology. Melodic recordings for XX participants could not be accessed for analysis, thus XX participants were included in this study. Eligible participants were between the ages of XX and XX (M = XX, SD = XX; XX females). Participants received course credit.

Melodies

Eight melodies, taken from XX and ranging from XX seconds and XX seconds in length, were chosen as the tonal stimuli for this study. These melodies were chosen in a previous study (Shanahan and Albrecht, *forthcoming*), because they were meant to mirror the process of oral transmission as much as possible, but were not prevalent enough that participants would be aware of them. The previous study therefore employed an orally transmitted repertoire that would be unfamiliar to our participants. In order to mitigate the effects of lyrics, the original study set out to find stimuli in which the songs were sung on a neutral syllable. A suitable corpus that fulfills all of these criteria can be found in Weiss, et al. (2012). This study involved “unfamiliar folk melodies from the United Kingdom and Ireland [that]...conformed to Western tonality” sung by “an amateur female (alto) singer without lyrics (i.e. “la” for each note) in an everyday (non-operatic) manner” (1075). The melody pitches were altered using Melodyne’s (2014) pitch center and pitch drift functions, and some note timings were manually adjusted for temporal accuracy.

Four of the chosen melodies included a re-do cadence, and four of the melodies included a ti-do cadence. Four vocalists (two men and two women) recorded two versions of each melody; one version included the original cadence, while the second version included the altered cadence.

**Measures of Musical Sophistication**

**Goldsmiths Musical Sophistication Index (Gold-MSI) Self Report.** Participants completed a 38-item self-report survey which included free response and Likert scale questions (the complete survey can be found at goo.gl/dqtSaB, Müllensiefen et al., 2014).

**Gold-MSI Beat Perception.** Participants were presented with 18 excerpts of instrumental music from rock, jazz, and classical genres (Müllensiefen et al., 2014). Each excerpt was presented for 10-16s through headphones and had a tempo ranging from 86-165bpm. A metronomic beep was played over each excerpt either on or off the beat. After each excerpt was played, participants decided if the metronomic beat was on or off the beat and indicated a confidence rating for their response from the following selection: “I am sure,” I am somewhat sure,” or “I am guessing.” The final score was the proportion of correct beat responses.

**Gold-MSI Melodic Memory.** Participants were presented melodies between 10 and 17 notes in length through headphones (Müllensiefen et al., 2014). During each trial, two versions of a melody were presented. The second version was transposed to a different key. There were 12 trials, 6 of which included the same melody and the other 6 with different melodies. In the different melody versions, a note was altered either a step up or down from its original position in the structure of the melody. After each trial, participants decided if the two melodies had identical pitch interval structures.

**Gold-MSI Sound Similarity.** XX

Measures of Working Memory Capacity

Participants completed one block each of three measures of working memory capacity (Foster et al., 2014). Each included a practice trial before the test trial.

**Operation Span (OSPAN).** Participants were tasked with completing a two-step math operation and then recalling a letter (F, H, J, K, L, N, P, Q, R, S, T, or Y) in an alternating sequence (Unsworth et al., 2005). The letter was presented visually for 1000ms after each math operation. During letter recall, participants were presented with a 4x3 matrix of all possible letters, each with its own check box. Participants clicked the check boxes for each letter in the serial order they recalled them being presented.

**Symmetry Span (SSPAN).** Participants were tasked with completing a two-step symmetry judgement and then recalling a visually presented red square on a 4x4 matrix in an alternating sequence (Unsworth et al., 2009). The square was presented in one of sixteen locations on a 4x4 matrix for 650ms after each symmetry judgement. In the symmetry judgement, participants were shown an 8x8 matrix with random squares filled in black, and they decided if the black squares were symmetrical about the matrix’s central vertical axis. During square recall, participants were presented with the 4x4 matrix and clicked the locations in the serial order they recalled the squares being presented.

**Rotation Span (RSPAN).** Participants were tasked with completing a two-step rotation match judgement and then recalling a visually presented arrow in an alternating sequence (Unsworth et al., 2009). The arrow was either of short or long length and pointed in one of eight different directions. In the rotation match judgement, participants were shown a rotated letter, and they decided whether the letter was presented correctly or as a mirrored image of the letter. During arrow recall, participants were presented with the sixteen possible arrows and clicked them in the serial order they recalled the arrows being presented.

**Procedure**

Participants in this study completed eight tasks in about 75 minutes.

In the first task, participants were asked to listen to, and then record themselves singing, eight unique melodies. Upon arrival, participants were assigned to one of two conditions. In Condition A, Melodies 1-4 were each presented in sets of 4 that included 3 re-do cadences and 1 ti-do cadence, while Melodies 5-8 were each presented in sets of 4 that included 3 ti-do cadences and 1 re-do cadence. In Condition B, Melodies 1-4 were each presented in sets of 4 that included 3 ti-do cadences and 1 re-do cadence, while Melodies 5-8 were each presented in sets of 4 that included 3 re-do cadences and 1 ti-do cadence. To carry out the experiment, we designed software in Max/MSP. The interface played the four versions of each unique melody, as recorded by four vocalists (two men and two women), in a random order with two seconds of silence between them. Then, following a ten-second break after the final version of the melody played, the interface recorded the participant’s own sung version of the melody. Participants were instructed to match the melody presented as best they were able. When they were finished recording, participants were given the option to either erase their current recording and re-record their rendition, or to continue on to the next melody set. During their session, the software logged data to an embedded dictionary, keeping track of their subject number, the playback order of each melody set’s audio files, and the number of times they opted to re-record their rendition of the melody before moving on to the next melody. At the end of each participant session, the research assistant is exported and saved the embedded dictionary log as a JSON file. Participants were able to learn this process during a practice trial before continuing on to the experimental melodies.

Participants then completed the Gold-MSI Self-Report, Beat Perception, Melodic Memory, and Sound Similarity Tests. Following that, they completed one block each of OSPAN, SSPAN, and RSPAN. Each task was administered on a desktop computer. Sounds were presented at a comfortable listening level for the tasks that required headphones. All participants provided informed consent.

Results

Our hypothesis stated that ti-do cadences would transform more often into re-do cadences than vice-versa through the act of oral transmission, despite the presentation of the opposite cadence alongside the original. Melodies recorded by participants sourced from the Department of Psychology were often difficult to label with solfege; as a result, we operationalized the re-do cadence as a descending cadence and the ti-do cadence as an ascending cadence. To test our hypothesis, 5 coders independently coded a subset of the melodies in the following way: assigned solfege to the final three pitches, discounting repeated pitches; provided a contour vector for the last three pitches; and labeled the movement from the penultimate pitch to the final pitch as “ascending” or “descending.”

Melodies 1-4 in Condition A and Melodies 5-8 in Condition B each were presented in sets of 4 that included 3 re-do cadences and 1 ti-do cadence; the presentations in this subset are referred to as Descending Dominant presentations. Melodies 1-4 in Condition B and Melodies 5-8 in Condition A each were presented in sets of 4 that included 3 ti-do cadences and 1 re-do cadence; the presentations in this subset are referred to as Ascending Dominant presentations.

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Discussion

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**XX.** XX

Conclusion

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